
DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention]About a laminated ceramic electronic component, in detail, the invention in this application is small size and high withstand pressure, and relates to a reliable laminated ceramic electronic component and a manufacturing method for the same.

[0002]

[Description of the Prior Art]As a laminated ceramic capacitor which is one of the typical laminated ceramic electronic components, Although what has the structure (normal structure) which allocated a ceramic layer (dielectric layer), the internal electrode pulled out by setting further to the both-ends side of a ceramic device (layered product) where the internal electrode was laminated by turns in the end face by the side of reverse, and the flowing exterior electrodes is common, The 1st cash-drawer electrode 52a linked to one exterior electrodes 54a allocated in one flat surface in the ceramic device (layered product) 51 as shown in drawing 7 in order to raise withstand voltage performance, The cash-drawer electrode layer A which consists of the floating internal electrodes 52c which set the predetermined interval and were allocated between the 2nd cash-drawer electrode 52b linked to the exterior electrodes 54b of another side, and the 1st and 2nd cash-drawer electrodes 52a and 52b. The laminated ceramic capacitor which has the structure which allocated by turns the float electrode layer B which consists of two or more floating internal electrodes 56 which set the same interval predetermined to one flat surface in the ceramic device 51, and were allocated via the ceramic layer 53 has come to be used.

[0003]In this laminated ceramic capacitor, Each capacitor (element) formed from each electrodes 52a, 52b, and 52c which constitute the cash-drawer electrode layer A, and each electrode 56 which constitutes the electrode layer A and the float electrode layer B which counters by pulling out via the ceramic layer 53 is constituted so that it may become a series connection between the exterior electrodes 54a and 54b.

[0004]However, in the case of the laminated ceramic capacitor of the series type which carried out the series connection of two or more capacitors in this way, withstand voltage performance improves, but since the capacitor is connected in series, acquisition electric capacity becomes small. Therefore, when it is going to acquire big electric capacity, it is necessary for an electrode (internal electrode) to stack and to increase number of sheets.

[0005]By the way, in the case of this series type of laminated ceramic capacitor, as shown in drawing 8, the both ends 51a and 51b of the ceramic device (layered product) 51, Since the cash-drawer electrode layer A and the ceramic layer 53 are only laminated and the float electrode layer B is not pulled out by the end, the physical thickness becomes small compared with the center section 51c of the ceramic device 51 in which it floated with the cash-drawer electrode layer A, and the electrode layer B and the ceramic layer 53 were allocated by turns. When an electrode stacks and number of sheets is increased, there is a tendency for the difference of the physical thickness of both ends and a center section to become still larger.

[0006]Thus, when the difference of the physical thickness of both ends and a center

section became large, and each class does not fully stick when a layered product is stuck by pressure, but a possibility of peeling arising and causing degradation of the characteristic between layers arises and it is stuck by pressure, As shown in drawing 9, the cash-drawer electrodes 52a and 52b change greatly, the thickness of the ceramic layer (dielectric layer) 53 of the neighborhood decreases, and there is a problem that electric field concentrates arise and desired withstand voltage performance is no longer obtained. [0007]The invention in this application solves the above-mentioned problem.

It aims at providing a laminated ceramic electronic component possible each class which constitutes a layered product sticking certainly, and being hard to produce peeling etc., and preventing generating of the electric field concentrates by modification of a cash-drawer electrode, reduction of the thickness of a ceramic layer (dielectric layer), etc. and reliable, and a manufacturing method for the same.

[0008]

[Means for Solving the Problem]To achieve the above objects, a laminated ceramic electronic component of the invention in this application (claim 1), Inside a ceramic device (layered product) by which exterior electrodes of a couple were allocated in the both-ends side, It is the laminated ceramic capacitor allocated so that an electrode connected to exterior electrodes and an electrode which is not connected might form a ceramic layer and multilayer structure, (a) The 1st cash-drawer electrode linked to one exterior electrodes allocated in one flat surface in a ceramic device, A cash-drawer electrode layer which consists of the 2nd cash-drawer electrode linked to exterior electrodes of another side, (b) Each electrode which a float electrode layer which set a predetermined interval at one flat surface in a ceramic device, and was allocated in it, and which consists of two or more floating internal electrodes which are not connected to exterior electrodes is allocated by turns via a ceramic layer, and constitutes a cash-drawer electrode layer, While each capacitor formed from each floating internal electrodes which constitute a float electrode layer is constituted so that it may become a series connection between exterior electrodes of a couple allocated in the both-ends side of a ceramic device, It is characterized by allocating a straw-man electrode which has thickness of said float electrode layer, and the thickness same in abbreviation so that it may expose to the direction both-ends side of a cash drawer of said cash-drawer electrode layer of the same flat surface as a flat surface in which said float electrode layer was allocated from a both-ends side of a ceramic device.

[0009]A laminated ceramic electronic component of claim 2, Inside a ceramic device (layered product) by which exterior electrodes of a couple were allocated in the both-ends side, It is the laminated ceramic capacitor allocated so that an electrode connected to exterior electrodes and an electrode which is not connected might form a ceramic layer and multilayer structure, (a) The 1st cash-drawer electrode linked to one exterior electrodes allocated in one flat surface in a ceramic device, A cash-drawer electrode layer which consists of at least one floating internal electrodes allocated between the 2nd cash-drawer electrode linked to exterior electrodes of another side, and the said 1st and 2nd cash-drawer electrodes, (b) Each electrode which a float electrode layer which set a predetermined interval at one flat surface in a ceramic device, and was allocated in it, and which consists of two or more floating internal electrodes which are not connected to exterior electrodes is allocated by turns via a ceramic layer, and constitutes a cash-drawer

electrode layer, While each capacitor formed from each floating internal electrodes which constitute a float electrode layer is constituted so that it may become a series connection between exterior electrodes of a couple allocated in the both-ends side of a ceramic device, So that it may expose to the direction both-ends side of a cash drawer of said cash-drawer electrode layer of the same flat surface as a flat surface in which said float electrode layer was allocated from a both-ends side of a ceramic device, It is characterized by allocating a straw-man electrode which has thickness of said float electrode layer, and the thickness same in abbreviation.

[0010]A laminated ceramic electronic component of the invention in this application (claims 1 and 2), So that it may expose to the direction both-ends side of a cash drawer of a cash-drawer electrode layer of the same flat surface as a flat surface in which a float electrode layer was allocated from a both-ends side of a ceramic device (layered product), Since he is trying to allocate a straw-man electrode which has thickness of a float electrode layer, and the thickness same in abbreviation, It becomes possible to make physical thickness of both ends of a ceramic device (layered product) almost equal to a portion laminated so that each electrode of a center section of the ceramic device may counter mutually via a ceramic layer, While being able to acquire adhesion sufficient at the time of sticking by pressure, modification of a cash-drawer electrode by the side of both ends of a ceramic device and electric field concentrates by thickness reduction of a ceramic layer (dielectric layer) are prevented, and it becomes possible to obtain desired withstand voltage performance.

[0011]A laminated ceramic electronic component of claim 3 is characterized by an interval of each electrode which constitutes one cash-drawer electrode layer, an interval of each electrode which constitutes one float electrode layer, and an interval of floating internal electrodes and a straw-man electrode which constitute an adjoining float electrode layer being the same in abbreviation.

[0012]When it is constituted so that an interval of each electrode may become the same, by a manufacturing process. When sticking a layered product by pressure, it becomes possible to apply a pressure to the whole uniformly, and modification of a cash-drawer electrode by the side of both ends of a ceramic device and electric field concentrates by thickness reduction of a ceramic layer (dielectric layer) are prevented, and it becomes possible to obtain desired withstand voltage performance.

[0013]A laminated ceramic electronic component of claim 4, A center section which constitutes a cash-drawer electrode layer, and a center section of the gap inter-electrode [each] which constitutes said float electrode layer of a gap inter-electrode [each], It is characterized by an electrode which constitutes said float electrode layer, and a center section of said straw-man inter-electrode gap setting interval same in abbreviation in the direction of a cash drawer of said cash-drawer electrode layer, and being allocated.

[0014]A center section which constitutes a cash-drawer electrode layer, and a center section of the gap inter-electrode [each] which constitutes a float electrode layer of a gap inter-electrode [each], an electrode which constitutes said float electrode layer, and a center section of said straw-man inter-electrode gap -- the direction of a cash drawer of a cash-drawer electrode layer -- abbreviated -- it becomes possible to apply a pressure still more uniformly by considering the same interval as composition set and allocated at the time of sticking by pressure -- the invention in this application -- further -- efficiency -- oh, it can close.

[0015] This invention is [manufacturing method of a laminated ceramic electronic component of the invention in this application (claim 5)] characterized by that a method of manufacturing the laminated ceramic electronic component according to any one of claims 1 to 4 comprises the following.

A ceramic green sheet in which two or more electrode patterns which have the specified shape for said cash-drawer electrode stratification were allocated in a fixed pitch in the direction of a cash drawer of said cash-drawer electrode layer.

A process to which two or more electrode patterns which have the specified shape for said float electrode stratification laminate and stick by pressure a ceramic green sheet allocated in a fixed pitch in the direction of a cash drawer of said cash-drawer electrode layer by turns.

A process of cutting a lamination-compression-bonding object by a position, and starting each ceramic device (uncalcinated layered product) so that said cash-drawer electrode and said straw-man electrode may be exposed to an amputation stump side.

A process of forming exterior electrodes so that it may flow with a process of calcinating a layered product which is not calcinated [said], and said cash-drawer electrode exposed to an amputation stump side of a layered product after calcination and said straw-man electrode.

[0016] A ceramic green sheet in which an electrode pattern for cash-drawer electrode stratification was allocated, So that it may pull out to an amputation stump side and an electrode and a straw-man electrode may be exposed, after laminating and sticking by pressure a ceramic green sheet in which an electrode pattern for float electrode stratification was allocated by turns, By manufacturing a laminated ceramic electronic component through a process of cutting a lamination-compression-bonding object by a position, it becomes possible to manufacture easily and certainly a laminated ceramic electronic component of the above-mentioned invention in this application.

[0017] A manufacturing method of a laminated ceramic electronic component of the invention in this application (claim 6) is [this invention] characterized by that a method of manufacturing the laminated ceramic electronic component according to any one of claims 1 to 4 comprises the following.

A process to which two or more electrode patterns of identical shape shift a position in the direction of a cash drawer of said cash-drawer electrode layer, and laminate and stick by pressure a ceramic green sheet of a specified number allocated in a fixed pitch in the direction of a cash drawer of said cash-drawer electrode layer to it only one half of allocation pitches of an electrode pattern, respectively.

A process of cutting a lamination-compression-bonding object by a position, and starting each ceramic device (uncalcinated layered product) so that said cash-drawer electrode and said straw-man electrode may be exposed to an amputation stump side.

A process of calcinating a layered product which is not calcinated [said].

A process of forming exterior electrodes so that it may flow with said cash-drawer electrode exposed to an amputation stump side of a layered product after calcination, and said straw-man electrode.

[0018] Two or more electrode patterns of identical shape a ceramic green sheet of two or more sheets allocated in a fixed pitch in the direction of a cash drawer of a cash-drawer

electrode layer, It cuts so that a lamination-compression-bonding object acquired by shifting and sticking [laminate and] a position by pressure only one half of allocation pitches of an electrode pattern may be pulled out to an amputation stump side and an electrode and a straw-man electrode may be exposed in the direction of a cash drawer of a cash-drawer electrode layer, respectively, By starting each ceramic device (uncalcinated layered product), it becomes possible to manufacture a laminated ceramic electronic component of the invention in this application efficiently, and reduction of a manufacturing cost can be aimed at now.

[0019]

[Embodiment of the Invention] Hereafter, the embodiment of the invention in this application is shown and the place by which it is characterized [the] is explained in more detail. This embodiment explains as a laminated ceramic electronic component taking the case of a laminated ceramic capacitor.

[0020][Laminated ceramic capacitor] Drawing 1 is a sectional view of the laminated ceramic capacitor concerning one embodiment of the invention in this application. This laminated ceramic capacitor is provided with the exterior electrodes 4a and 4b of the ceramic device (layered product) 1 and the couple allocated in those both ends (the both-ends side S1 and S2 are included) as shown in drawing 1.

[0021] The 1st cash-drawer electrode 2a that connects the ceramic device 1 with one exterior electrodes 4a allocated in one internal flat surface, The cash-drawer electrode layer A which consists of the floating internal electrodes 2c allocated between 2nd cash-drawer electrode 2b linked to the exterior electrodes 4b of another side, and the 1st and the 2nd cash-drawer electrode 2a and 2b. . Set the same interval predetermined to one flat surface in the ceramic device 1, and were allocated. Each electrode 2a which has the structure where the float electrode layer B which consists of two or more floating internal electrodes 6 which are not connected to the exterior electrodes 4a and 4b was allocated by turns via the ceramic layer 3, and constitutes the cash-drawer electrode layer A, 2b, and 2c, Each capacitor formed from each floating internal electrodes 6 which constitute the float electrode layer B is constituted so that it may become a series connection between the exterior electrodes 4a and 4b.

[0022] And in this laminated ceramic capacitor, it exposes to the both-ends [of the direction of a cash drawer of the cash-drawer electrode layer A of the same flat surface as the flat surface in which the float electrode layer B was allocated] 1a, and b [1] side from the both-ends side S1 of the ceramic device (layered product) 1, and S2 -- as -- the thickness of the float electrode layer B -- abbreviated -- the straw-man electrode 10 which has the same thickness is allocated.

[0023] In this laminated ceramic capacitor, As shown in drawing 2, The one cash-drawer electrode layer A formed in the same flat surface. Each electrode 2a, 2b to constitute, And the interval of 2c. (Gap) G1, the interval (gap) G2 of each electrode 6 which constitutes the one float electrode layer B formed in the same flat surface, and interval (gap) G3 of the floating internal electrodes 6 and the straw-man electrode 10 which constitute the adjoining float electrode layer B -- abbreviated, while being constituted so that it may become the same, The center section of each inter-electrode one 2a which constitutes the cash-drawer electrode layer A, 2b, and the gap G1 of 2c, The center section of the gap G2 between each electrode 6 which constitutes the float electrode layer B, and gap G3 of the floating internal electrodes 6 and the straw-man electrode 10 is

allocated so that it may become the same interval (allocation pitch) L as the direction of a cash drawer of the cash-drawer electrode layer A.

[0024]Next, the manufacturing method of this laminated ceramic capacitor is explained. [Manufacturing method 1 of a laminated ceramic capacitor] First, as shown in [drawing 3](#), the electrode printing sheet 13 is produced by printing two or more electrode patterns 12 of identical shape (rectangle) to matrix form on the ceramic green sheet 11 using a predetermined stencil.

[0025]and this electrode printing sheet 13 is shown in [drawing 4](#) (a) and (b) -- as -- much more -- it being alike, and, while shifting a position only one half of the allocation pitches of an electrode in the direction of a cash drawer of the cash-drawer electrode layer A and carrying out specified number lamination, The lamination-compression-bonding object (Mother lamination-compression-bonding object) 14 as shown in [drawing 4](#) (c) is produced by laminating and sticking by pressure the ceramic green sheet (cover sheet) in which conductive paste is not printed to the up-and-down both-sides side. This lamination-compression-bonding object 14 contains two or more ceramic devices 1, and the ceramic device 1 which constitutes the laminated ceramic capacitor of [drawing 1](#) is obtained by cutting the part shown with the dashed line Z using a dicing saw, the cutting edge, etc. Namely, by cutting the lamination-compression-bonding object 14 in the position shown with the dashed line Z according to the method of this embodiment, The float electrode layer B which the cash-drawer electrode layer A which consists of the 1st and the 2nd cash-drawer electrode 2a, 2b, and the floating internal electrodes 2c is formed from the electrode pattern 12, and consists of two or more floating internal electrodes 6, and the straw-man electrode 10 are formed.

[0026]Only by according to the above-mentioned manufacturing method, using one kind of electrode arranging sheet 13 formed by printing the electrode pattern of predetermined shape using one kind of stencil, laminating and sticking this by pressure, and cutting by a position, The ceramic device 1 of structure as shown in [drawing 1](#) and [drawing 2](#) can be formed easily. And the laminated ceramic capacitor of structure as shown in [drawing 1](#) is obtained by forming the exterior electrodes 11 in the both ends of the ceramic device 1 formed as mentioned above.

[0027]The laminated ceramic capacitor of this embodiment, So that it may expose to the both-ends side of the direction of a cash drawer of the cash-drawer electrode layer A of the same flat surface as the flat surface in which the float electrode layer B was allocated (the direction of the arrows X and Y of [drawing 1](#)) from the both-ends side S1 of the ceramic device (layered product) 1, and S2, Since the straw-man electrode 10 which has the thickness of the float electrode layer B and the thickness same in abbreviation is allocated, The physical thickness of the both ends 1a and 1b of the ceramic device (layered product) 1 becomes almost equal to the center section 1c currently allocated so that each electrode may counter mutually via a ceramic layer, and adhesion sufficient at the time of sticking by pressure also at the both ends 1a and 1b of the ceramic device 1 is acquired. Modification of the cash-drawer electrode 2a connected with the exterior electrodes 4a and 4b by the side of the both ends of the ceramic device (layered product) 1 and 2b is controlled, it becomes possible to prevent the electric field concentrates by thickness reduction of the both ends 1a and 1b of the ceramic device 1, and desired withstand voltage performance can be obtained.

[0028]In the laminated ceramic capacitor of this embodiment, As shown in [drawing 2](#),

while making the same the interval G1 of each electrode, G2, and G3, The center section of each electrode 2a which constitutes the cash-drawer electrode layer A, 2b, and the gap G1 between 2c, Since a center section and the center section of gap G3 between the electrode 6 which constitutes the float electrode layer B, and the straw-man electrode 10 of the gap G2 between each electrode 6 which constitutes the float electrode layer B set the same interval L in the direction of a cash drawer of the cash-drawer electrode layer A and are allocated, At the time of sticking by pressure, a pressure will be added still more uniformly and it becomes possible to prevent more certainly thickness reduction of the cash-drawer electrode 2a, and modification of 2b and the both ends 1a and 1b of the ceramic device 1.

[0029][Manufacturing method 2 of a laminated ceramic capacitor] in this embodiment. As shown in drawing 5 (a), while producing the electrode printing sheet 23 by printing two or more electrode patterns 22a and 22b of two kinds of predetermined shape on the ceramic green sheet 11. As furthermore shown in drawing 5 (b), the electrode printing sheet 33 was produced by printing two or more electrode patterns 32a and 32b which have two kinds of predetermined shape on the ceramic green sheet 11. In the electrode printing sheet 23 and the electrode printing sheet 33, each electrode pattern was formed by printing conductive paste using a stencil different, respectively. Drawing 5 (a) and (b) shows only a part for a single tier among the electrode patterns formed in the electrode printing sheets 23 and 33.

[0030]And while carrying out specified number lamination of these electrode printing sheets 23 and 33 by turns so that it may become physical relationship as shown in drawing 5 (a) and (b), The lamination-compression-bonding object 34 as shown in drawing 5 (c) is formed by laminating and sticking by pressure the ceramic green sheet (cover sheet) in which conductive paste is not printed to the up-and-down both-sides side. This lamination-compression-bonding object 34 contains two or more ceramic devices 1, and the ceramic device 1 which constitutes a laminated ceramic capacitor as shown in drawing 1 is started by cutting the part shown with the dashed line Z using a dicing saw, the cutting edge, etc.

[0031]In the manufacturing method 2 of this laminated ceramic capacitor, Since the lamination-compression-bonding object 34 as shown in drawing 5 (c) by forming two kinds of electrode printing sheets 23 and 33, and using these electrode printing sheets 23 and 33 using two or more stencils is acquired, It becomes possible to obtain the ceramic device 1 only by cutting along the dashed line Z, and it is not necessary to cut at two places of the boundary part of the portion used as each element, and it becomes possible like the manufacturing method 1 of the above-mentioned laminated ceramic capacitor to simplify a cutting process.

[0032]Also in other points, the effect which applies correspondingly in the case of the manufacturing method 1 of a laminated ceramic capacitor can be acquired.

[0033]The 1st cash-drawer electrode 2a that the cash-drawer electrode layer A connects with one exterior electrodes 4a in the above-mentioned embodiment, Although explained taking the case of the case where it is formed from the floating internal electrodes 2c allocated between 2nd cash-drawer electrode 2b linked to the exterior electrodes 4b of another side, and the 1st and the 2nd cash-drawer electrode 2a and 2b, The 1st cash-drawer electrode 2a that the cash-drawer electrode layer A connects with one exterior electrodes 4a as the invention in this application is shown in drawing 6, It is possible to

apply also to the laminated ceramic capacitor of the type with which it is formed from 2nd cash-drawer electrode 2b linked to the exterior electrodes 4b of another side, and the floating electrode is not formed between the 1st and the 2nd cash-drawer electrode 2a, and 2b. In drawing 6, the portion which attached drawing 1 and identical codes shows the same or considerable portion.

[0034]At the above-mentioned embodiment, although explained taking the case of the laminated ceramic capacitor, the invention in this application is a series type, and can be applied to various laminated ceramic electronic components of small size and high withstand pressure.

[0035]It is possible for the invention in this application not to be further limited to the above-mentioned embodiment in other points, to relate to concrete shape and numbers, such as a cash-drawer electrode, floating internal electrodes, and a straw-man electrode, or an allocation mode, and to add various application and modification within the limits of the gist of an invention.

[0036]

[Effect of the Invention]As mentioned above, the laminated ceramic electronic component of the invention in this application (claims 1 and 2), So that it may expose to the direction both-ends side of a cash drawer of the cash-drawer electrode layer of the same flat surface as the flat surface in which the float electrode layer was allocated from the both-ends side of a ceramic device (layered product), Since he is trying to allocate the straw-man electrode which has the thickness of a float electrode layer, and the thickness same in abbreviation, It becomes possible to make physical thickness of the both ends of a ceramic device (layered product) almost equal to the portion laminated so that each electrode of the center section of the ceramic device may counter mutually via a ceramic layer, While being able to acquire adhesion sufficient at the time of sticking by pressure, modification of the cash-drawer electrode by the side of the both ends of a ceramic device and the electric field concentrates by thickness reduction of a ceramic layer (dielectric layer) can be prevented, and desired withstand voltage performance can be obtained.

[0037]The interval of each electrode which constitutes one cash-drawer electrode layer formed in the same flat surface like the laminated ceramic electronic component of claim 3, When it is presupposed that it is the same in abbreviation of the interval of each electrode which constitutes one float electrode layer formed in the same flat surface, and the interval of the floating internal electrodes and the straw-man electrode which constitute a float electrode layer, When sticking a layered product by pressure by a manufacturing process, it becomes possible to apply a pressure to the whole uniformly, and modification of the cash-drawer electrode by the side of the both ends of a ceramic device and the electric field concentrates by thickness reduction of a ceramic layer (dielectric layer) are prevented, and it becomes possible to obtain desired withstand voltage performance.

[0038]The center section of the gap inter-electrode [each] which constitutes a cash-drawer electrode layer like the laminated ceramic electronic component of claim 4, When the center section which constitutes a float electrode layer, and the electrode which constitutes said float electrode layer and the center section of said straw-man inter-electrode gap of the gap inter-electrode [each] carry out the interval same in abbreviation in the direction of a cash drawer of a cash-drawer electrode layer with the

composition set and allocated, it becomes possible to apply a pressure still more uniformly at the time of sticking by pressure -- the invention in this application -- more -- efficiency -- oh, it can close.

[0039]The manufacturing method of the laminated ceramic electronic component of the invention in this application (claim 5), The ceramic green sheet in which the electrode pattern for cash-drawer electrode stratification was allocated, So that it may pull out to an amputation stump side and an electrode and a straw-man electrode may be exposed, after laminating and sticking by pressure the ceramic green sheet in which the electrode pattern for float electrode stratification was allocated by turns, Since he is trying to manufacture a laminated ceramic electronic component through the process of cutting a lamination-compression-bonding object by a position, the laminated ceramic electronic component of the above-mentioned invention in this application can be manufactured easily and certainly.

[0040]The manufacturing method of the laminated ceramic electronic component of the invention in this application (claim 6), Two or more electrode patterns of identical shape the ceramic green sheet of two or more sheets allocated in the fixed pitch in the direction of a cash drawer of a cash-drawer electrode layer, It cuts so that the lamination-compression-bonding object acquired by shifting and sticking [laminate and] a position by pressure only one half of the allocation pitches of an electrode pattern may be pulled out to an amputation stump side and an electrode and a straw-man electrode may be exposed in the direction of a cash drawer of a cash-drawer electrode layer, respectively, Since he is trying to start each ceramic device (uncalcinated layered product), it becomes possible efficiently about the laminated ceramic electronic component of the invention in this application easy and to manufacture certainly and economically.







